

## CHAPTER 2. INVENTORYING AND EVALUATING POTENTIALS OF EXISTING HABITAT

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### 2-1. General.

**2-1.1. Definition and Scope.** Habitat may be defined as the place where a plant or animal species naturally lives and grows or as the environment in which the life needs of an organism, population, or biological community are supplied. Sometimes, when a component, such as food or water, is either lacking or not present in adequate quantity or quality to meet the needs of a species, it can be supplied by management. The extent to which man can supply these missing components or can manage habitat to support larger populations of a species depends, in large part, on what he has to work with and the tolerance range of a species to different factors.

**2-1.2. Requirements for Different Species.** Some wildlife species have much more exacting requirements than others. For example, the nesting range of the Kirtland warbler is restricted to a relatively small area in the northern part of the Lower Peninsula of Michigan. The birds nest on the ground in sandy soil areas which contain stands of young jack-pine, five to 18-feet high, with ground cover of sweet fern, bearberry, and blueberry. The presence of open grown stands of young pine with living branches near the ground appears to be a very specific habitat requirement. To keep the pine canopy from closing and the trees from growing too tall, it is necessary, in the absence of forest fires which formerly occurred in the area, to do controlled burning. Similarly, in Florida, the Everglade kite is dependent upon a certain type of snail for its food. The birds are now confined largely to the Loxahatchee National Wildlife Refuge where marsh vegetation needed for nesting and aquatic areas for snails are being protected. On the other hand, the range of some animals such as the raccoon and opossum has increased; the house sparrow, starling, and common pigeon have all adapted well to urbanization, and the creation of fish ponds and other impoundments have made it possible to produce fish where fish habitat did not previously exist.

### **2-1.3. Inventory and Evaluation.**

**2-1.3.1. Existing Conditions.** Basically, a wildlife manager works with the soil, water, and vegetation in an area and with existing wildlife populations

whose diversity and size reflect the carrying capacity of an area. Wildlife management should recognize the environmental limitations of an area. Fish and wildlife populations should be related to existing habitat. Then, through evaluation of the soil, water, vegetation, and other environmental factors, together with a knowledge of fish and wildlife requirement, a determination should be made as to the potentials for fish and wildlife management through habitat manipulation.

**2-1.3.2. Trends and Potentials for Management.** Fish and wildlife inventories, conducted as described in Chapter 3, should be indicative of habitat conditions in a given area. If an analysis of annual population estimates over a period of years shows a decline in bobwhite quail and an increase in ruffed grouse, it probably indicates a decrease in farming activity and successive vegetative growth in old fields to brush and saplings, possibly supplemented with pine plantations. Increases in squirrel and wild turkey beyond this point may mean that plant succession has reached the stage of more mature forests with large, mast-bearing trees. Creel censuses showing a decline in bass and a preponderance of pan fish in fish ponds may indicate that there is too much fishing pressure on the predatory fish and not enough on the pan fish. Thus, a wildlife manager should know not only present habitat conditions but also habitat changes or trends, and how to counteract adverse trends. Among the changes, nationwide, are: the vast acres converted to urban use and the land use for more than 3.8 million miles of roads and streets. These developments have reduced wildlife habitats on both military and nonmilitary lands. Generally, little attention has been paid to the wildlife management potential of roadside rights-of-way and other lands associated with these developments. A wildlife or natural resources manager should evaluate not only the possibilities for maintaining or improving agricultural land and land in old fields, forests, and ranges but also land around housing developments, office buildings, warehouses, roadsides, and other improved areas. Roadsides, and rights-of-ways, provide travel zones, and edge effect, for some species, especially the endangered Red Cockaded woodpecker.

**2-1.3.3. Information Needed.** In discussing procedures for inventory and evaluation, it is possible to provide a general framework, only, of suggested approaches. Although a well-trained and experienced wildlife ecologist can develop some valid conclusions about existing habitat and its management potentials from short periods of visual inspection, preferably at different seasons of the year, a thorough inventory and evaluation of habitat is far more conclusive. Ideally, it involves: mapping vegetation, soils, and such features as roads and water bodies; photographs; and quantitative and qualitative measurements of physical, biological, and chemical features of the area. In inventorying and evaluating habitat with a view towards improved management, knowledge of the requirements of the species to be managed are necessary. Also, the extent and intensity of habitat evaluation depends upon management goals and objectives. Finally, experience has shown that it is often desirable to use techniques designed for a specific situation; i.e., a good method for measuring forage in understory vegetation may not be as good for measuring shrub vegetation valuable to birds.

## **2-2. Reconnaissance-Type Evaluation with Special Reference to Terrestrial Habitat.**

**2-2.1. Accumulating Data.** In terrestrial areas, a reconnaissance-type evaluation will suffice for many management purposes. Such an evaluation primarily involves the preparation and/or use and interpretation of vegetation and soil maps and an assessment of food availability, either as agricultural crops or wild plant species. Preliminary to mapping, an area should be inspected by a wildlife specialist to note the types of wildlife present and to identify those portions of the area which require detailed vegetation maps. Also, the literature should be surveyed to determine if any publications describe the vegetation of the area. Copies of any relevant soil maps and any available records which show present and past land use, disturbance by fire, use of pesticides, severe floods, and the like should be assembled. Sometimes, it is possible to obtain unpublished information on soil types in a specific area from the local Soil Conservation Service or the state soil conservationist at the state agricultural experiment station. They may also help interpret soil maps or analyze soil with respect to the need for liming or fertilizing for increased production of food crops or to the suitability for construction of fish ponds or other impoundments. Topographic maps from the Geological Survey (app C, No. 6) should also be ob-

tained. In addition to topography, these maps show stream courses and other features important in evaluating habitat. Finally, aerial photographs of an area are valuable. They may be available from the U.S. Department of Agriculture (app C, No. 4), the US Department of the Interior (app C, No. 6), the National Aeronautics and Space Administration (app C, No. 2) or the Department of Defense. Otherwise, for small areas, it may be possible to take large scale photographs. Photographs, particularly at a scale of 1:8,000 or less, taken of the same area at intervals of several years provide much information on land use, vegetation, and other trends and development.

**2-2.2 Information Gaps.** When available information has been assembled and interpreted, a wildlife manager can better determine what information is needed to complete the inventory and habitat evaluation.

**2-2.3. Mapping and Recording Information.** The emphasis in mapping and recording is likely to be upon vegetation in wooded, wetland, and old field areas rather than on cultivated fields, but consideration should also be given to the vegetation of roadsides and other developed areas. Mapping and analysis should identify the physical or geographic location of these areas in relation to cropland fields and should provide information on the composition and density of vegetation comprising the overstory, the understory, and the ground vegetation of wooded areas. Streams, lakes, and wetlands should be delineated on the maps, along with roads, developed areas, and military use sites.

**2-2.3.1. Agricultural Areas.** Habitat evaluation should reveal: the type, distribution, and acreage of agricultural crops; the liming and fertilizing needed to increase productivity; the planting and harvesting methods employed in relation to grain available as food; and the feasibility of permitting portions of crops to remain unharvested next to good cover as a wildlife management technique. It should show also the crop rotation in the various fields in case some alteration of the rotation might provide better diversity of food and cover. In mapping, careful attention should be given to delineating the width, plant composition, density, and height of vegetation along field borders, woods, and drainage ditches. Such borders provide travel lanes for wildlife and enable many species to feed on standing grain or crop residues or to nest in areas which otherwise might not be available to them. In mapping and evaluating old fields no longer tilled, the stage of grass or woody plant invasion should be noted. If much of the cover is made up of broom-

sedge or other grasses of relatively low wildlife value, the possibility of stimulating growth of annual plants with greater food value by liming, light application of fertilizer and disking should be noted. Also, if field inspections and soil and topographic maps reveal favorable conditions for construction of a small impoundment, it should be noted as a possibility for providing greater habitat diversity. Areas of well-drained, fertile soil close to woody cover may be indicated as potential sites for wildlife food plots. Opportunities should be noted, also, for development of cover lanes which intersect old fields and connect them with other existing cover. Special note should be made of tracts of native prairie grasses. Scrutiny of past land use and the incidence of fire in an area may suggest ways of maintaining these valuable biological communities, such as prescribed burning or some grazing.

**2-2.3.2. Forest and Rangeland Areas.** Many of the same approaches are applicable to forest and rangeland areas. However, it may be possible in the analyses of these more permanent habitat types to measure present conditions of the vegetation and then, make later measurements of the same areas or transects to determine long-term trends. In wooded areas, in particular, it is important to note the species and their densities and distribution in the ground cover, understory, and overstory vegetation. Probably this can best be done by establishing line transects through an area and conducting periodic

inventories of the vegetation. Photographs of the transects and the use of a score card to record the condition of the vegetation are helpful. From a practical standpoint, it is important to note the number, size, and distribution of openings occurring in wooded areas. Such openings provide diversity of food and cover and may serve as breeding areas for many wildlife species. Any browse lines evident in areas not subject to grazing or browsing by domestic livestock should be noted as probable evidence of too many deer (fig 2-1). Forested areas with few openings should be recorded in order that the wildlife manager may consider creation of openings to improve conditions for grouse and other wildlife. Similarly, the presence of den trees and of plant species especially valuable as wildlife food sources should be indicated in the habitat inventory. Nesting trees for species such as the endangered bald eagle should be clearly designated, and roosting trees for such species as the wild turkey should be noted. The presence of linear habitat types resulting from power line and railroad rights-of-way, ditches, and roads, including logging roads, should be indicated on maps. Information about the existing management of rights-of-way vegetation should be recorded. Possibilities for improvement, such as maintaining buffer strips of vegetation between roads and streams or planting grass mixtures or shrubs on road rights-of-way for cover and food, should be noted.



*Figure 2-1. Deer browsing.*

**2-2.3.3. Improved or Developed Areas.** It is recommended that the inventory and evaluation of habitat include improved or developed areas, such as installation entrances, roadways, headquarters and office building areas, housing areas, golf courses, and other recreation areas. It is here that most personnel will have an opportunity to observe wildlife on a day-to-day basis. Feeding, watering, and nesting sites can be provided in cantonment areas. Habitat evaluation for these areas should note the width of grass areas along roads and the types and spacing of shrubs and trees. If roadside vegetation consists of broad strips of closely cut grass, a wildlife manager may recommend reducing the width of the mowed area and permitting the remainder to revert to more natural vegetation, or he may suggest planting shrubs valuable to wildlife. If the grounds around office buildings and living quarters

have little diversity of vegetation, he may recommend planting additional species beneficial to wildlife and converting the area from tall trees and grass to several layers of vegetative cover. Less frequent mowing of grass may also be advisable.

**2-2.4. Sampling.** In large areas, it is impractical to measure in detail the vegetation in the entire area; hence, vegetative sampling is done, usually by means of sample plots. The size and number of plots depend upon the kind, density, and distribution of the vegetation. Larger plots, one-fifth acre or more in size, are necessary for trees; one twenty-fifth acre has been suggested for shrubs; and plots of one one hundredth acre may suffice for herbaceous ground cover. Sampling vegetation is discussed in many publications, including *Wildlife Investigation Techniques* which is available from the Wildlife Society (app No. 14).

**2-2.5. Evaluating and Ranking.** Methods of evaluating and ranking different types of habitat for different species have been developed into a Handbook for Habitat Evaluation Procedures (App A). Although written specifically for a site in Crawford County, Missouri, this handbook contains criteria that can be applied to the oak-hickory forest section of the eastern deciduous forest. Also, it can be used as a prototype for developing handbooks for other parts of the nation. The authors suggest first determining the habitat types for each region; then determining from an extensive literature search the habitat needs for each species. Evaluation elements are identified; criteria for measuring the capability of an area to support the species or groups of species in question are developed; and forms are prepared for rating the various characteristics of the area in the field. The most critical habitat factors can be given a maximum score of 10; less critical factors range only to a maximum of five. On the evaluation form, provision is made for both the possible and actual scores for the habitat characteristics and for a total habitat value. The U.S. Fish and Wildlife Service 1979 publication entitled *Habitat Evaluation Procedures (HEP)* provides guidelines to facilitate the evaluation of resource development project impacts on wildlife resources from a habitat approach. The Service has developed *Species Criteria Handbooks* to be used with their procedures. These documents are available through the Project Impact Evaluation Team Office, Division of Ecological Services, Fish and Wildlife Service, US Department of the Interior, 2625 Redwing Road, Fort Collins, Colorado 80526.

**2-3. Stream Habitat Surveys.** Stream habitat surveys should involve measurement and evaluation of physical, biological, and chemical characteristics.

**2-3.1. Physical Data.** In addition to mapping streams, information should be compiled on: the velocity, width, depth, temperatures and volume of the stream flow at different seasons of the year; the gradient; flooding frequency and extent of time; type of bottom; and areas suitable for spawning beds. Information on low flow may be crucial for different aquatic organisms. Methods for developing a physical analysis to evaluate instream flow needs are treated in considerable detail in *Investigation into Methods for Developing a Physical Analysis for Evaluating Instream Flow Needs* (app B, No. 81). In areas with abundant groundwater, it may be possible to improve trout streams, for example, by augmenting low flows with pumped groundwater, as described in *Improvement of Trout Streams in*

*Wisconsin by Augmenting Low Flows with Groundwater* (app B, No. 78). The evaluation should indicate those streams which, because of roadbuilding or other construction, have been channelized and may need to be rehabilitated with low dams, reflectors, or other devices. Existing or planned road construction which requires culverts on streams used by anadromous fish should be noted to assure that the culverts are designed to permit stream passage of these fish. The presence of dams or other barriers should be recorded. In the case of intermittent streams, the presence or absence of deep holes which retain water during dry periods should be indicated. The stream inventory should reveal the presence of oxbow lakes, waterfalls, pools, and stretches of riffles, as well as quiet backwaters and islands which may be important to wood ducks and beaver. Descriptions of the streambank soil and its stability are also helpful. Information on the land forms or geologic formations may be useful in determining both susceptibility to erosion and the type and nature of the bottom material in the stream. Bottom materials may be categorized as sand, silt, clay, muck, fine gravel, coarse gravel, rubble, boulder, or exposed bed rock.

**2-3.2. Biological Data.**

**2-3.2.1. Animal Populations.** Biological surveys should include not only the various fish but also the organisms on which they feed. Vegetation, both within the stream and along the bank and adjacent land areas, has an important bearing on fish and wildlife using the stream habitat. Suggestions on inventorying fish populations appear in paragraph 3-14. Assistance in inventorying insects and other aquatic invertebrates may be obtained from respective state conservation departments or, perhaps, from local universities. Usually, aquatic vertebrates are collected with specifically designed equipment such as bottom samplers. Samples are taken from transects across riffles, pool areas, and elsewhere from bank to bank, are stored in a preservative, and are then sorted and analyzed in a laboratory. The population-size and diversity of species can reveal much about the quality of the aquatic habitat. Evidence of beaver activity should be recorded, including whether beaver cuttings are current or old, and whether beaver dams exist. Such dams may be of considerable importance to fish and waterfowl production.

**2-3.2.2. Vegetation.** Vegetation on stream banks and in adjacent areas should be noted according to principal species, height, and density. The percentage of the stream water surface that is shaded

at midday should be noted, as well as the extent to which there is vegetation overhanging the stream at different heights. It is suggested in Techniques for Conducting Stream Habitat Surveys on National Resource Land (app B, No. 29) that vegetation must be twice as high as the distance to the water's edge to be effective for shade and water temperature control. From this standpoint, higher vegetation is most effective. However, from the standpoint of aquatic cover and, presumably, the insects and other food materials falling into the water, vegetation overhanging the surface within a foot is most valuable, as suggested in A Handbook for Habitat Evaluation Procedures (app A, No. 8). Vegetation in the stream may be described as to occurrence of higher plants (e.g., shrubs), algae, and mosses, or as to occurrence of submergent (pondweeds, Elodea, waterweed, water milfoil, etc.), emergent (cattails, bulrushes, etc.), and floating (duckweeds, water hyacinths, waterlilies, etc.) plants. The importance of some of these plants will be discussed later. If plant life is rare or absent, it should be noted on the inventory form. The presence of tree tops or other debris which may provide cover should also be noted.

**2-3.3. Chemical and Water Quality Measurements.** Water quality measurements include water temperature, turbidity, pH, dissolved oxygen, carbon dioxide, alkalinity, and conductivity or total dissolved solids. Measurements may be needed, also of nitrates-nitrites, phosphates, trace minerals and heavy metals, sulfates, sediments, detergents, and other pollutants. Note should be made of any evidence of pollution. Installations should utilize the services of military medical or environmental laboratory personnel who make field visits for the purposes of sampling and or continuous monitoring to determine environmental quality deficiencies.

**2-3.4. Additional Information.** Helpful suggestions for conducting stream habitat surveys appear in Techniques for Conducting Stream Habitat Surveys on National Resource Land (app B, No. 29). Also useful is "Geomorphic and Aquatic Conditions Influencing Salmonids and Stream Classification with Application to Ecosystem Classification" (App B, No. 85).

**2-4. Lake and Impoundment Habitat Surveys.** A map of the lake or impoundment should be obtained if one is available, or one should be made.

**2-4.1. Physical Data.** There should be one map showing the relation of the lake or impoundment to other features of the area, including wooded areas, agricultural fields, and other bodies of water. A

more detailed map showing contours, depth, and other features such as shoreline, islands, and inlet and outlet streams is also necessary. Additional desirable information for the map includes the location of dams or other water control structures and evident beds of emergent vegetation. For ponds and larger impoundments, information on the source of water should be provided. Generally, the same types of physical, biological, and chemical information required for stream habitat surveys (para 2-3) are needed for lake and impoundment surveys. Knowledge of the fluctuation in water volume and depth can be important, as well as information on the thermocline and turnover and mixing of the water, and the potential for fish kill during winter freeze-ups. Management involving the use of chemicals in ponds or small lakes requires, for best results, that the volume of water be known. Often the volume is determined by surface area times mean depth or by the flow rate through fill pipes. In small, unstratified ponds, it is possible to obtain similar results by adding feed-mixing salt to the pond and determining the increase in chloride concentration through titration. Pond volume may be calculated by the formula  $V = W / (C \times 2.718144)$ , where V is the volume of the pond in acre-feet, W is the weight (in pounds) of added chlorides, and C is the change in concentration of Cl in parts per million. This formula is further discussed in "Salt Method for Determining Pond Volume" (app B, No. 86). Data on the length and type of shoreline and on bottom types can provide clues to the potential for fish spawning beds or for use by shorebirds and other wildlife.

**2-4.2. Biological Surveys.** The biological survey should provide information on fish in addition to floating, emergent, and submerged plants present. Plankton samples provide some indication of the productivity of a lake. The presence of abundant populations of tubefid worms, leeches, or rat-tail maggots (the larvae of *Syrphus* flies or the so-called "pollution fungus", *Sphaerotilus natans*) may be indicative of pollution from domestic sewage. While emergent plants around the edges of an impoundment may provide good habitat for aquatic furbearers, they may interfere with fishing.

**2-4.3. Water Quality.** The same types of measurements discussed in subparagraph 2-3.3. should be part of the lake and impoundment survey. Water temperatures and dissolved oxygen content should be taken at the surface, at the bottom, and in the thermocline zone, in order to provide information as to the limitations or capabilities of deeper impoundments to support both cold and

warmwater fisheries. Turbidity may be of considerable concern in some reservoirs and lakes since it reduces photosynthesis and overall productivity and may harm fish directly. Sometimes, in shallow water, carp will cause turbidity. If fish sampling, which should be a part of the habitat evaluation procedure, indicates too many carp or other coarse or undesirable fish, the biologist may wish to remove them.

## 2-5. Wetland Habitat Surveys.

**2-5.1. Definition.** There is some overlap in wetlands with riverine habitat, with small, shallow lakes and ponds, and with the marshy vegetation which may surround larger lakes. Wetlands are covered by shallow and, sometimes, temporary or intermittent waters. They include marshes, wet meadows, bogs, swamps, potholes, dugouts, sloughs, wet river-bottom lands, and areas of waterlogged soils.

**2-5.2. Importance for Wildlife.** Wetland habitats are important in the production of waterfowl and aquatic mammals. They also provide food and cover for many other species such as woodcock, pheasant, raccoon, deer, heron, crane, and many song birds. Salt marshes are important components of the estuarine zone and are among the most productive of habitats, biologically.

**2-5.3. Physical Data.** It is desirable to have good maps showing the size and location of wetlands in relation to the overall area of concern. The area map should show general cover and land use, roads, buildings, fence rows, drainage ditches, streams, and other features. In addition, soils maps and information on soil-water conditions should be made available. A detailed map of the wetland area should also be prepared. The above information, coupled with data from wildlife population inventories and a knowledge of the requirements of individual species, should enable a wildlife manager to assess present habitat and determine its potential for further development.

### 2-5.4. Plant-Soil-Water Relationships.

**2-5.4.1.** The detailed map or maps should show the amount of open water in a wetland area in relation to areas of emergent vegetation and vegetation on the surrounding uplands. Information is needed on the depth of potholes or other open water areas and on the quality of the water. In the important duck-producing area of the Dakotas and Minnesota, it has been found that, with the mallard, a small pond will accommodate only one or two pair of mated birds during the mating period. Thus, the number of ponds or potholes is critical to the breeding requirements of this species, even if some of the ponds dry up after incubation of the eggs begins.

Once the ducklings have hatched, however, the deeper potholes with permanent water are needed for brood rearing. By this time the territorial defense mechanism which prevents more mallards from utilizing the deep-water pothole during the mating season is no longer operative and several broods of mallards can occupy the deeper water body. Thus, where deeper potholes are not surrounded by shallower ponds, a wildlife manager may wish to consider creating open water areas in the surrounding emergent vegetation. Opportunities and conditions necessary for creating greentree reservoirs to attract waterfowl are treated in subparagraph 6-2.5.10.

**2-5.4.2. Vegetation maps should be sufficiently detailed to indicate the major species or types of aquatic plants present and the height and density of the cover.** Vegetation in the near vicinity of the water areas should be mapped also. For example, if within the breeding range of the wood duck, there are few trees on wet river-bottom lands with cavities suitable for the nesting of this species, this fact should be noted. Then, in evaluating the potential wildlife productivity of the area, the wildlife manager may wish to install nest boxes for this species. Similarly, if the habitat inventory shows soil and water conditions suitable for the growth of alders within the range of the woodcock, the manager may wish to plant or encourage the growth of alder thickets, a favorite habitat for woodcock. It should be noted that in addition to the chemical analyses of soil and water which should be a part of a comprehensive evaluation of wetland habitat, vegetation in itself can be indicative of the prevailing conditions. For example, pickerel weed, burrweed, and arrowhead may indicate moderately low pH while saltmarsh bulrush, saltgrass, and glasswort are typical of alkaline areas with a pH of 7 or above. Salt marsh cordgrass in large unbroken stands is an indicator of regularly flooded salt marshes. The Techniques Handbook of the Waterfowl Habitat Development and Management Committee (app B, No. 4) provides very helpful guidelines for habitat evaluation and its development and management in the Atlantic Flyway.

**2-6. Technical Assistance.** Much attention is being given to the classification, inventory, conservation, and management of fish and wildlife habitat by many Federal agencies. The Fish and Wildlife Service, in cooperation with other agencies and organizations, sponsored a symposium in 1977, on "Classification, Inventory, and Analysis of Fish and Wildlife Habitat". Proceedings of this symposium should be invaluable in developing systematic,

ecologically-based classification schemes. The Fish and Wildlife Service is also engaged in developing a classification of wetlands and aquatic habitats of the United States and procedures for evaluating water and related land resource development projects as they relate to monetary and nonmonetary fish and wildlife values. Further information can be obtained by contacting the Fish and Wildlife Service (app C, No. 6). The Bureau of Land Management (app C, No. 6) is deeply involved in developing an integrated habitat analysis system in-

corporating biomes described as tundra, boreal forest, coniferous forest, deciduous forest, woodland—brushland, grassland, desert, and ocean. The Bureau has also produced a series of informative "Technical Manual Supplements" dealing with the life history and habitat requirements of such species as the pronghorn antelope, mule deer, dabbling duck, mourning dove, and sage grouse. The Forest Service (app C, No. 4) is engaged in comprehensive inventories of forest and related resources, including fish and wildlife.